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Service

**Northern
Region**

Old-Growth Forests: Managing for Wildlife

MANAGING OLD-GROWTH FORESTS AS WILDLIFE HABITAT: AN ECOSYSTEMS APPROACH

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Introduction

The past decade has been one of increasing environmentalism. Initially, concern was voiced by individuals and groups asking new questions about a spectrum of environmental problems, including management of public lands. The first attempts to answer these questions were fragmented, and uncoordinated, and proved unacceptable. One reason land managers were unable to deal with these problems was because society was developing new values. Thus, new management criteria and goals were in order. Moreover, it became apparent that a fundamental reevaluation of land management processes was needed. That is, a comprehensive framework was needed to adequately address the new problems, goals and opportunities, and thus select management options based on rational decisions and sound data.

Recent legislation reflects the demand for environmentally sound management and provides an opportunity to develop a comprehensive framework for Federal lands. The following legislation and resulting land management policies indicate the new trend: Multiple-Use Sustained Yield Act of 1960; National Environmental Policy Act of 1969; Endangered Species Act of 1973; Wilderness Act of 1973; Resource Planning Act of 1974; and the National Forest Management Act of 1976. To comply with the mandate for ecologically sound management, the land manager has adopted an ecosystem approach to decisionmaking. To this end, the Wildlife and Fisheries division of the USDA-Forest Service, Northern Region is developing a broad, or "holistic" approach to wildlife management. This report on "old-growth" forests and its attendant wildlife is a part of the holistic program.

In general, the holistic or ecosystem approach to wildlife management provides a framework for land managers to evaluate all aspects of wildlife-related management actions. The data base for this system covers, for example, all 637 wildlife species found in the Northern Region--habitat requirements, distribution, status, and so on, and the impacts of certain land management options. Data are analyzed with the aid of a computer, which has both an extensive information base and manipulative capabilities to display consequences. This report will be concerned with the final stage of forest successional stage, and the management implications and recommendations resulting from the utilization of that successional stage.

OLD-GROWTH FORESTS

Definition of Terms

A review of the literature indicates much ambiguity concerning the definition of old-growth forests. Some authors have set an age criteria for old-growth. McClelland (1977) defined old-growth in the western larch (Larix occidentalis) ponderosa pine (Pinus ponderosa), and grand fir (Abies grandis) cover types to be stands older than 200 years. Stands of the Douglas-fir (Pseudotsuga menziesii) timber type in the Pacific Northwest are defined as old-growth when beyond 120 years (Wight 1974). Ponderosa pine stands are classified as old-growth beyond 200 years (Wight 1974, Meslow and Wight 1975). Other authors determined the old-growth successional stage in coniferous forests to occur anywhere from 160 years up to 200 years in age (Thomas et al. 1975, Thomas et al. 1977). However, as tree species, site conditions, and management treatments differ with locality, so will the rate of succession, and consequently, the age at which old-growth stands appear. A better criteria for old-growth forests is based on a combination of structural factors, which include overstory, canopy, dead and down material, level of decadence, and age (Bull 1978, and USDA-FS 1978).

Overstory. In ponderosa pine and mixed conifer stands, at least 15 of the larger overstory trees per acre must exceed 20 inches in diameter at breast height (d.b.h.). In lodgepole pine (Pinus contorta) stands, at least 15 of the larger overstory trees per acre must exceed 6 inches d.b.h. Large birds of prey such as the goshawk (Accipter gentilis) and the large owls will nest in these large overstory trees. Eventually some trees will become snags suitable for the larger primary excavators such as the pileated woodpecker (Dryocopus pileatus).

Canopy. The canopy must be multilayered, uneven-aged, and relatively closed. The total crown closure should exceed 70 percent in all types except ponderosa pine, where it should exceed 50 percent. The layers will provide microclimate for other components of the old-growth forest such as nitrogen fixing lichens (Juday 1977).

Dead and Down. Old-growth stands must have a high level of dead and rotting material, both standing and down. In mixed conifer types, snags larger than 20 inches d.b.h. should be at least 0.5 per acre. In ponderosa pine types there should be more than 1.5 snags per acre larger than 20 inches d.b.h. Snags will provide nest and roost sites for cavity-users; downfall provides insect foods, cover, and den sites for certain species.

Decadence. The old-growth stand contains a relatively high degree of decadence, which is indicated by heart rot, mistletoe, diseased trees, dead

or broken tree tops, and mosses or lichens. The diversity of conditions created by decadence in turn provides for diversity in the manner of wildlife species utilizing these conditions.

Age. Most of the above criteria will be present for different timber types at the following time spans:

Lodgepole pine:	80+ years
Douglas-fir:	120+ years
Mixed Conifer:	160+ years
Ponderosa pine:	200+ years

In this review, forests with the above outlined components will be referred to as "old-growth". It should be noted that old-growth is not synonomous with climax stands. For example, western larch is not a climax species. However, western larch stands may occupy a site for several hundred years or more and thus acquire old-growth characteristics. The larch stand may eventually be replaced with an Engelmann spruce (Picea engelmannii) subalpine fir (Abies lasiocarpa) climax forest, or be recycled and perpetuated by fire or some other disturbance which retards succession (McClelland 1977, Hagenstein 1977).

Juday (1977) listed several other unique components of old-growth forests which supply a variety of ecosystem niches. Lichens, characteristic of old-growth forests, are vital to the growth of Northwest coniferous forests. Lichens are a rich source of nitrogen, and are especially important when other sources appearing in earlier successional stages (shrubs such as ceanothus for example) are eliminated as competition with the timber crop. In addition, the "debris dam" component helps produce high quality water in streams flowing through old stands. Debris dams, composed of dead materials which gather in stream channels, promote bank stability and low stream sediment loads.

As more information becomes available on the relationships of wildlife and old-growth components, it will be necessary to update criteria for old-growth stands.

WILDLIFE SPECIES ASSOCIATED WITH OLD-GROWTH

Old-growth in timber stands provides unique ecological niches for wildlife species. An understanding of wildlife utilization and interrelationships in old-growth will shed further light on the significance of old-growth and, correspondingly, appropriate management recommendations concerning old-growth.

Dependency Upon Old-Growth

A review of the literature shows some conflicting interpretations of wildlife dependency upon old-growth. (Bull 1978:78) found:

> For the bird species, old-growth is considered an optimum habitat rather than essential to their survival, as these species may occur in other successional stages in other areas but may be at lower densities or with reduced levels of survival and reproduction.

Meslow and Wight (1975) found that 69 percent of the birds in Douglas-fir types use old-growth. More than half of the species nested within the old-growth stage. Three species are listed as nesting primarily within old-growth: spotted owl (Strix occidentalis); goshawk; and Vaux's swift (Chaetura vauxi). Wight (1974) described the old-growth stage as very stable, and the species that use that stage as highly adapted and specialized. Consequently, Wight expressed concern that these species would not be able to quickly readjust their living strategies at a rate commensurate with the rapid liquidation of old-growth forests. Wight (1974:38) further predicted these species "are doomed if a forest-management scheme does not provide for preservation of mature forest habitats on which they absolutely dependent".

Bull (1978) listed six species which are primarily associated with old-growth. These included the great gray owl (Strix nebulosa), barred owl (S. varia), flammulated owl (Otus flammeoulus), white-headed woodpecker (Dendrocopus albolarvatus), northern three-toed woodpecker (Picoides tridactylus), and Townsend's warbler (Dendrocia townsendii).

Thomas et al. (1975) discussed the importance of old-growth to cavity-nesters and added that in coniferous forests, approximately 20 percent of the total breeding pairs were cavity-nesters. They further discussed typical bird species of old-growth forests such as: spruce-hemlock zone: boreal owl (Aegolius funereus); fir zone: spotted owl; and pine zone: pileated woodpecker.

McClelland (1979) discussed the general trend toward increased species richness of cavity-nesting bird species from young to old-growth stands of larch and Douglas-fir in northwestern Montana. He noted the importance of old-growth in providing an adequate number of nest sites for cavity-nesters. He explained the role of ecological disturbances such as lightning, fire, disease, and insects acting upon large, old trees. These processes produce large snags with heartwood decay, attractive to primary excavators.

Moreover, the snags are large enough to accomodate the largest primary excavator in the areas, the pileated woodpecker. Appendix B lists cavity-nesters in the Northern Region. Although the bulk of his dissertation was directed to the importance of old-growth in providing suitable habitat for cavity-nesters, McClelland listed several open-nesters that nest primarily in old-growth, such as the pine grosbeak (Pinicola enucleator), Townsend's warbler, black-headed grosbeak (Pheucticus melanocephalus), varied thrush (Ixoreus naevius), sharp-shinned hawk (Accipiter striatus), and goshawk. In addition, he noted the importance of old-growth as thermal cover for big game and as marten (Martes americana) habitat.

Winn (1974) also found marten closely associated with old-growth forests. He considered the arboreal life and denning habits of the marten in lodgepole communities to apparently require the larger size trees, which are a product of open, old-growth stands. In addition, he considered the red squirrel and flying squirrel to require the snag component of old-growth.

Koehler and Hornocker (1977) found mature spruce-subalpine fir forests provided cover and food requirements for marten in winter. In winters of normal snowfall, marten activity was highest in stands with canopy cover densities greater than 30 percent.

A literature review of several forest birds conducted by the Pacific Northwestern Region of the USDA-Forest Service noted several species that require old-growth elements. The goshawk and white-headed woodpecker were mentioned (Jackman and Scott 1975).

Members of the 1978 forest workshops on the Lolo National Forest separated old-growth species into three categories based upon tolerance for habitat modifications. A summary of the criteria for the three categories follows (USDA-Forest Service 1978):

A. Species dependent on old-growth or undisturbed forests. Species in this category require nearly undisturbed old-growth for feeding and reproduction. Densities of both species and individuals is greatest at 90 to 100 percent canopy closure. See species list in appendix C.

B. Species tolerating limited modification of old-growth. Species need a majority of overmature trees in the stand for feeding and reproduction. Population levels are greatest at a crown closure of 70 percent or greater. Several management techniques may be compatible if the above requirements are met and harassment is minimized. Such activities include precommercial thinning to 10 feet or less, and commerical thinning. In addition, salvage and

select tree removal may be permitted. Thinning practices may, over time, enhance old-growth stands by removing competition factors and allowing the remaining trees to reach an increased d.b.h. Also, regeneration of seral species (shade-intolerant species such as larch) is stimulated. In this way thinning mimics natural disturbances such as fire, and suitably large snags for primary excavators may be produced. Appendix D lists these factors.

C. Species tolerating moderate modification of old-growth. Species in this group require some mature-to-overmature trees in the stand for feeding and reproduction. Optimum crown canopy for the greatest species' densities is 40 percent or greater. Several timber management activities may be compatible with these requirements, as long as some mature-to-overmature trees are retained to at least 40 percent canopy closure, harassment is minimal, and a comparable amount of subordinate natural vegetation is retained. Appendix E lists these species.

Maser et al. (1977) discussed wildlife use of dead and down woody material in the Blue Mountains of Washington and Oregon. Some 179 vertebrate species used dead and down material for feeding, cover, reproduction, or other activities such as drumming, perching, and sunning. The degree of dependence on dead and down timber, however, was not assigned.

For purposes of making forest land allocation decisions, several Forest Service biologists correlate old-growth stand size requirements and the species' dependence. The Pacific Northwestern Region lists wildlife dependent on old-growth, based on an assumed low rate of habitat "substitutability" for a species and its population density. Lists for four timber types have been compiled (appendices F-I). The stand size (acreage) of old-growth on an extended rotation which is necessary to sustain viable populations of wildlife is also listed in appendix J-1 (Deibert 1978).

Deibert (1978) similarly listed old-growth wildlife species and assigned each a management tolerance rating and a dependency rating (appendix J-2). The tolerance rating refers to a species tolerance to different timber practices. The dependency rating provides an overall rating which reflects a species dependency on old-growth stands. For example, species that require undisturbed old-growth stands and receive a "very high" dependency rating include the following: boreal red-backed vole (Clethrionomys gapperi); fringed myotis (Myotis thysanodes); white-headed woodpecker; western jumping mouse (Zapus princeps); northern flying squirrel (Glaucomys claifornicus); hermit thrush (Hylocichla guttata); and merlin (Falco columbarius).

Juday (1977) discussed the ecology of old-growth forests in Douglas-fir stands of the Coast Ranges and Cascade Mountains. Several old-growth specialists mentioned include the following: tree swallow (Iridoprocne bicolor); Townsend's warbler; hermit warbler (Dendrocia occidentalis); Hammond's flycatcher (Empidonax hammondii); western flycatcher (E. difficilis); golden-crowned kinglet (Regulus satrapa); ruby-crowned kinglet (R. calendula); goshawk; spotted owl; red tree vole (Arborimus longicaudus); bushy-tailed woodrat (Neotoma cinerea); and northern flying squirrel.

The Wildlife and Fisheries Division of the Northern Region has assembled a data base by means of a literature search and review. Information concerning wildlife species associated with old-growth was reviewed. Some 373 wildlife species associated with forest habitats were considered. Of 373 forest-related species, 43 percent are associated with old-growth for either feeding or reproduction, or both (figure 1).

The degree of preference for old-growth is next examined. Of 373 forest-related wildlife species, 12 percent prefer old-growth to five other successional stages for either feeding or reproduction (figure 2). The graph indicates high use of the first stages, which probably reflects preferred use of these stages for feeding. Also, lower, but nevertheless significant preference for mature-to-overmature stands is shown. This probably reflects use by cavity-nesters and other species which reproduce in old-growth. The high use of the first successional stages is consistent with findings of Wight (1974). Bull (1978) displayed graphs with similar axes for the avifauna of the Blue Mountains in Oregon. Bull found increased use of the old-growth stage for both feeding and reproduction (figure 3). The differences in figures 2 and 3 probably reflect the relatively higher proportion of cavity-nesting species among birds compared to the lower proportion of cavity-nesting species among all forest-related wildlife.

Figure 4 displays the number of "old-growth-associated" species that could possibly utilize the other successional stages for feeding and reproduction. Of the 164 old-growth species 29 percent prefer old-growth for either feeding or reproduction. The graph indicates the 164 old-growth species probably use mature-to-old stands for reproduction. Also, the graph shows relatively stable use of the other stages preferred for either feeding or reproduction. This may indicate that the species could utilize alternative successional stages if essential components of old-growth, such as snags, are present. Also, this may indicate preference for the earlier stages for feeding areas.

The 48 "old-growth-preferred" species are next investigated for preferences for other successional stages for feeding and reproduction. Of 48 species that prefer old-growth, 97 percent prefer old-growth for reproduction.

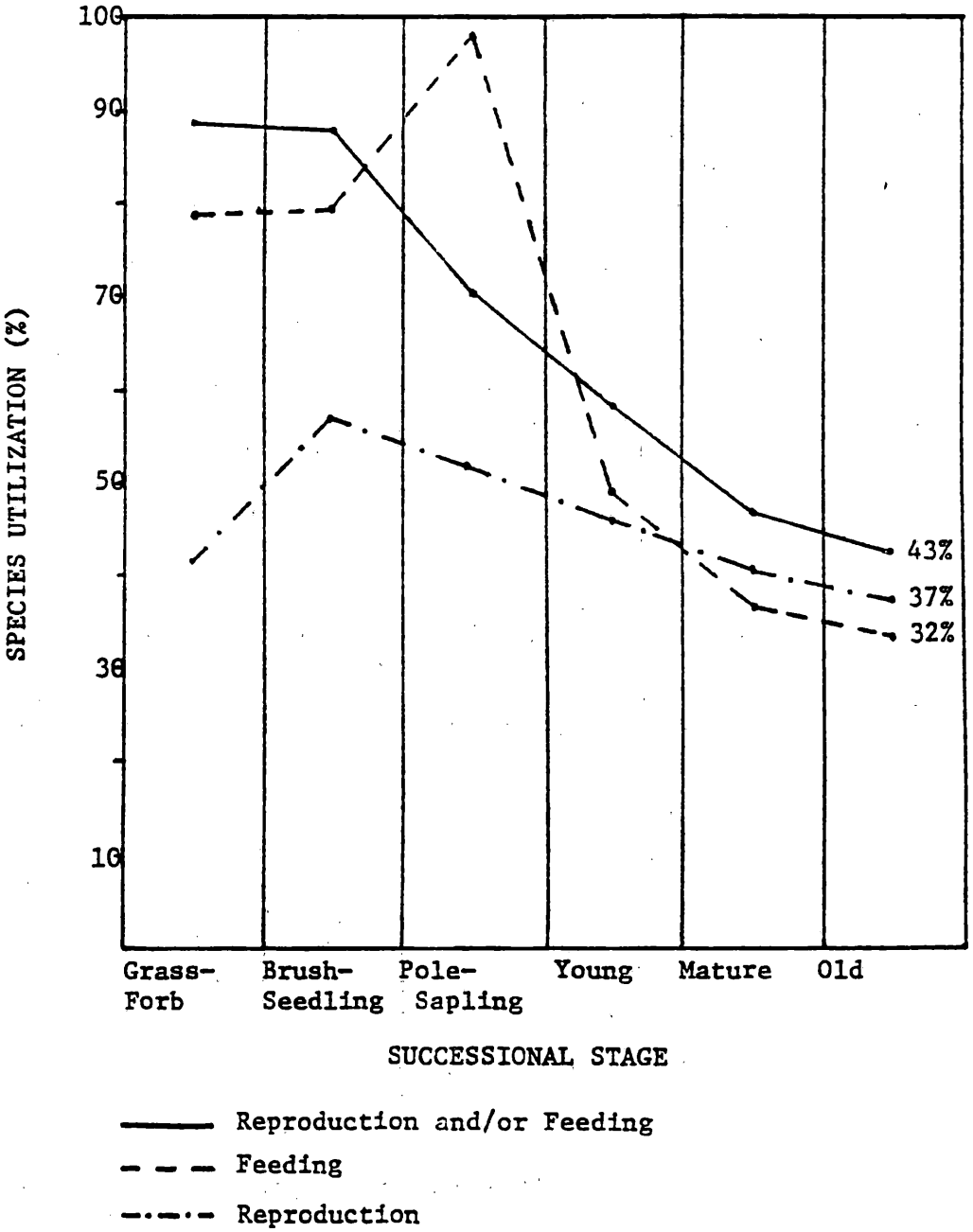

Figure 1 -- Wildlife species that feed or reproduce (or both) in various forest successional stages (Total: 373 species; after Bull 1978).

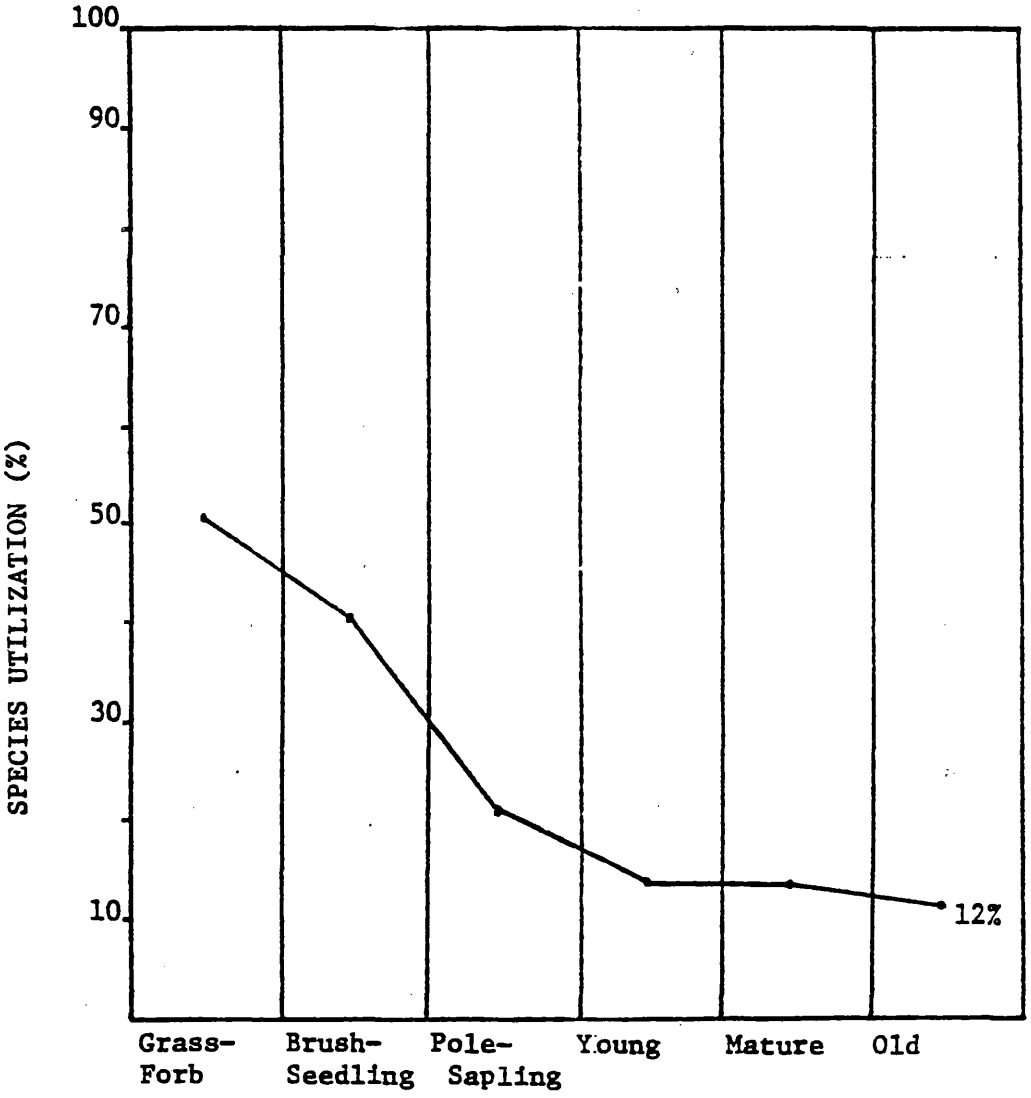

Figure 2 -- Forest successional stages <u>preferred</u> by wildlife for feeding, reproduction, or both (373 species).

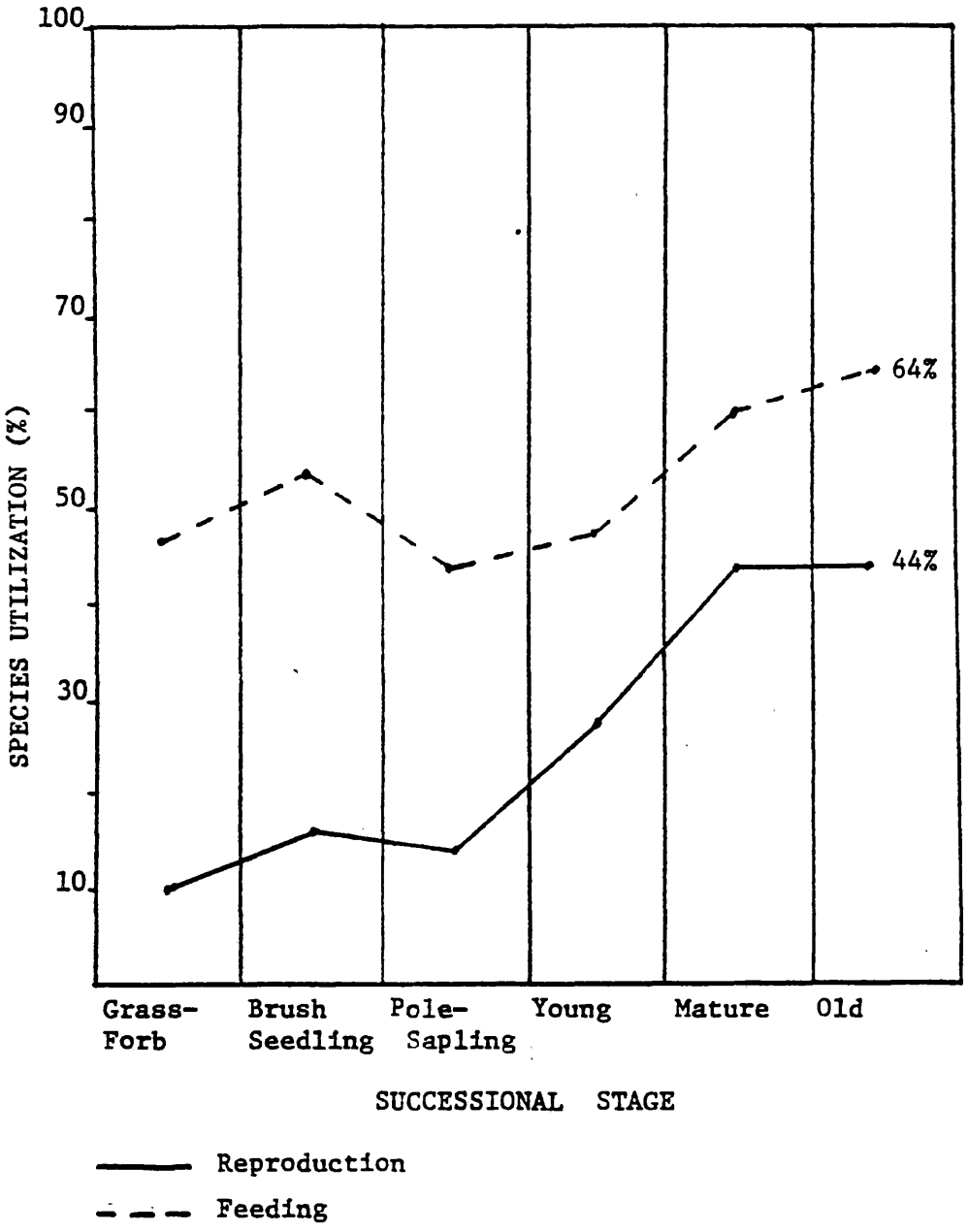

Figure 3 — Number of birds utilizing forest successional stages for nesting and feeding in the Blue Mountains, Oregon (118 birds in commercial forest types; Bull 1978:79).

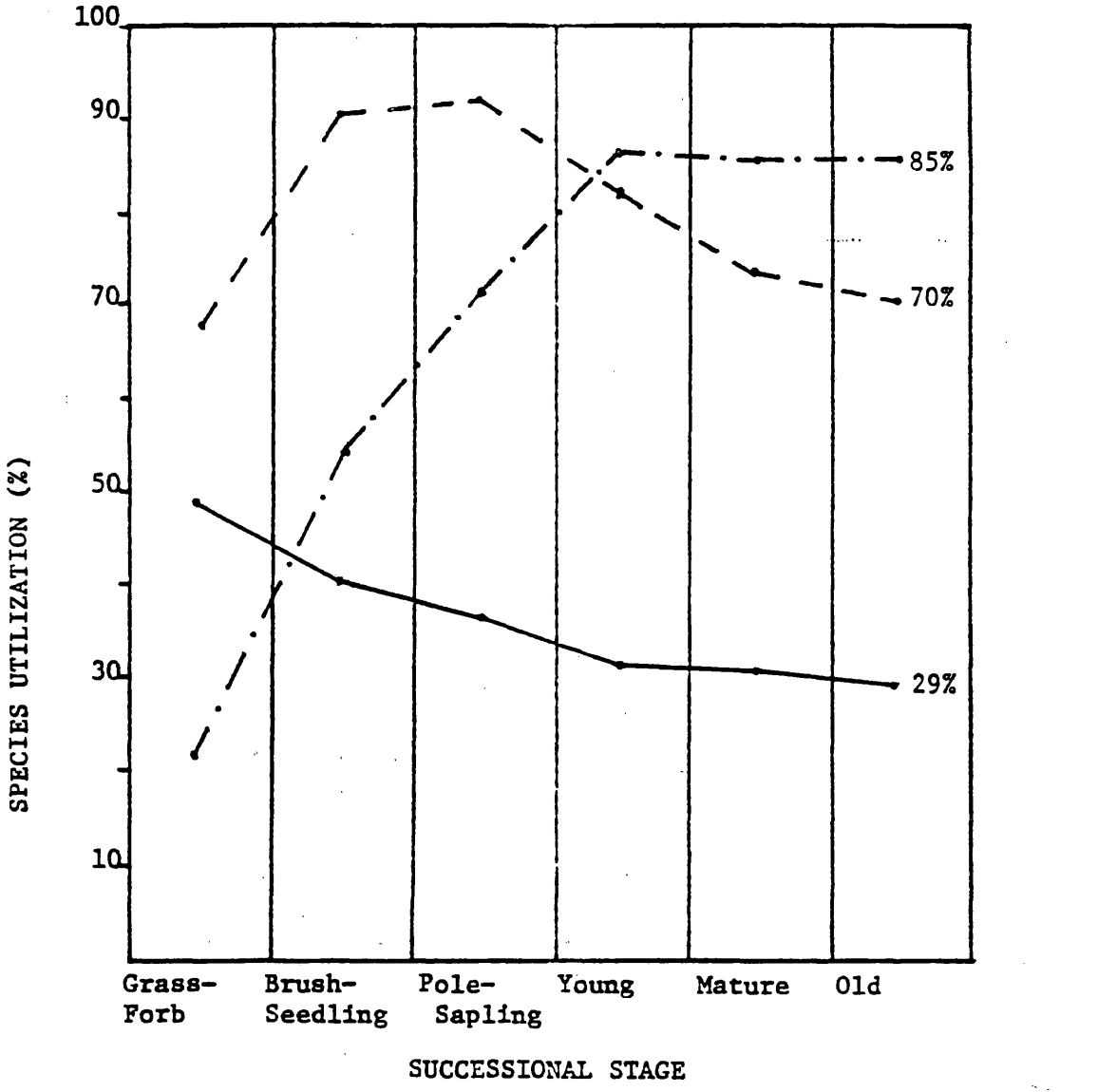

Figure 4 -- "Old-Growth-Associated" species that may utilize alternative successional stages for feeding and reproduction (species total: 164).

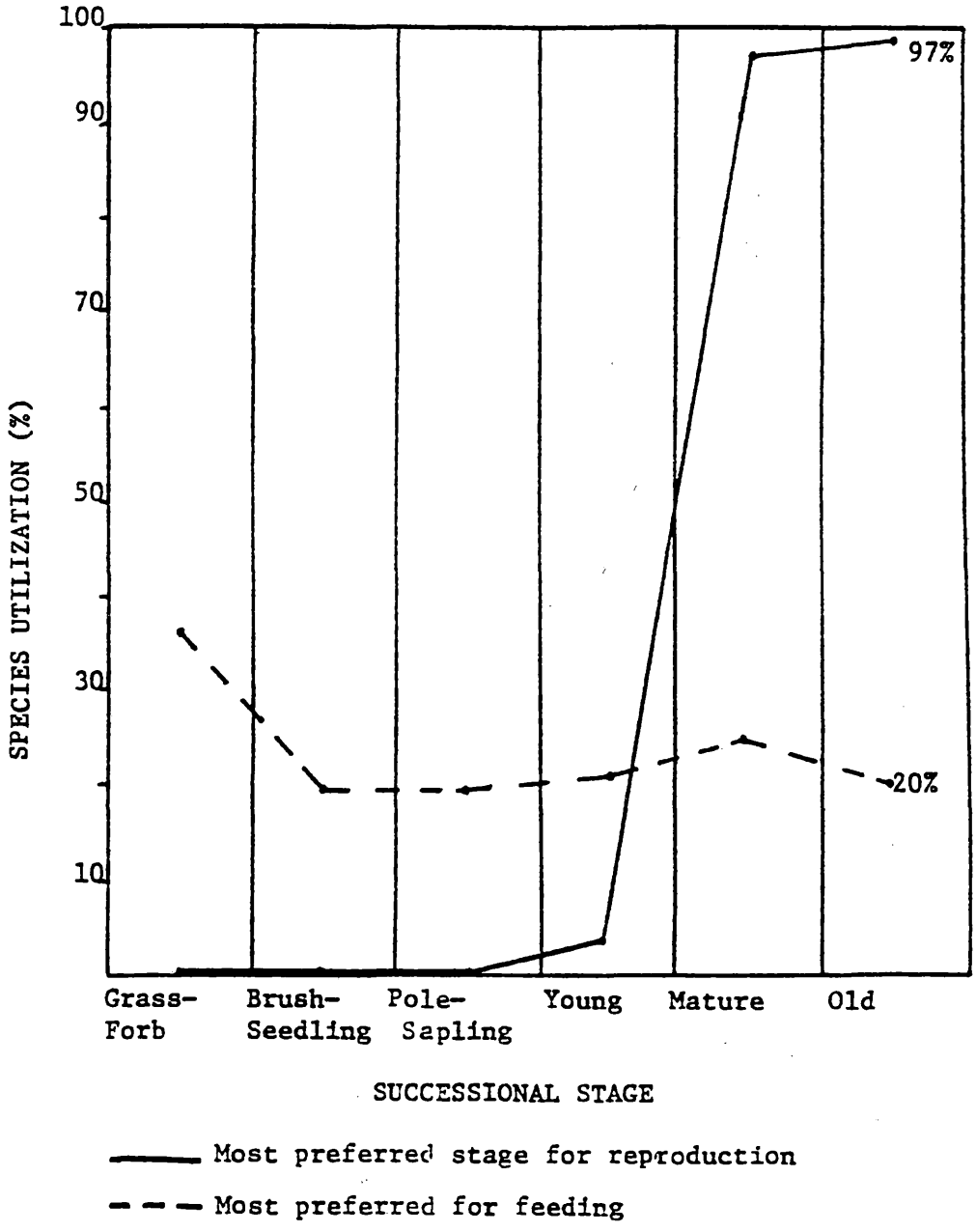

Figure 5 -- "Old-Growth-Preferred" species that also prefer other successional stages for feeding and reproduction (48 species).

Moreover, none of the 48 species would use the first three stages for reproduction, and only two species would use young stands. However, 95 percent also prefer mature stands for reproduction. This indicates the essential components of old-growth for these reproductively dependent species may be provided in mature stands as well as old stands.

A summary of the 48 old-growth species and the old-growth components they use can be found in appendix A. Examination of the utilization of essential old-growth components, as well as acknowledgement of other habitat requirements will suggest the management guidelines necessary to insure viable, self-sustaining populations of these species. After guidelines are implemented, the group, or selected members of the group, may be used as a barometer for monitoring the effectiveness of old-growth management. Several representative members that might be selected as "indicator species" include the following: pileated woodpecker; fisher (Martes pennanti); marten; lynx (Lynx lynx); boreal redback vole; wolverine (Gulo gulo); white-headed woodpecker; the three-toed woodpeckers; hermit thrush; and varied thrush. With increased information concerning species' habitat requirements, appendix A will be revised. Correspondingly, it will be possible to select species that better reflect the needs and essential requirements of the groups as a whole.

Dependency Upon Habitat Types

Data pertaining to the dependency of wildlife on certain habitat types of old-growth is not readily available. McClelland (1977) noted the preference of larch stands over Douglas-fir stands for cavity-users. He recommended the retention of 10 percent of the acreage of western larch, ponderosa pine, and grand fir cover-types to be saved in old-growth.

Biologists on the Lolo National Forest Planning Team summarized species' use of successional stages by habitat types and stand size. They concluded that old-growth must be retained in all minimum size units (20, 80, 160, 320, and 1,000 acres) in all habitat types to provide for all dependent species. (USDA-Forest Service 1978). This approach seems reasonable considering incomplete knowledge of the habitat preferences of old-growth-associated species. Management recommendations will be discussed below.

Ramsden et al. (1976) suspected structure is independent of habitat type in a study of small bird populations in western Montana.

Review of the Northern Region's data base indicates the following habitat types are most preferred by 48 "old-growth-preferred" species:

Group 3--Ponderosa pine/snowberry, chokecherry
Group 6--Douglas-fir/snowberry, ninebark, pinegrass
Group 28--Elm, ash, cottonwood, dogwood
Group 2--Ponderosa pine/bluestem, wheatgrass-fescue, bitterbrush
Group 29--Willow, birch, alder, aspen (appendix K)

AMOUNT OF OLD-GROWTH AVAILABLE

The acres of old-growth and the rate of liquidation of old-growth is next examined. Management goals, opportunities, and priorities may be determined from this information.

Precise figures on the acres of old-growth in the Northern Region are not readily available. Timber resource managers provided information and acreages that follow.

Timber managers suggest old-growth stands are probably classified for silvicultural purposes as "mature saw timber, high risk" (D. Deden 1978 personal communication). High risk stands are defined as stands expected to be severely decimated in 20 years due to old age, insects, or disease. In addition, the mean annual increment of growth is quite low. Acreages for this stage of growth are assembled by timber types (tables 1 and 2).

Traditionally, the timber management goals for high risk stands have been liquidation and subsequent conversion to short-rotation periods, with intensive management practices. That is, dead and dying trees are not allowed to accumulate, large snags are removed, disease, insect damage, and fire are suppressed, and the effects of other natural disturbances are mitigated. Thus, the natural ecological processes that produce old-growth components are interrupted or otherwise nullified. A review of the literature indicates much concern over the rapid removal of old-growth forests (Winn 1970, Wight 1974, McClelland 1977, Juday 1978, USDA-Forest Service 1978). Tables 1 and 2 show management options for certain timber types are quickly diminishing, or have already been lost. The Lolo National Forest, for example has no more old-growth, or very little old-growth remaining in many timber types. In addition, the Lolo National Forest assumes a conversion period of approximately 85 years when the last old-growth will be cut (USDA-Forest Service 1978). Thus, as old-growth forests are eliminated, wildlife dependent upon old-growth habitat will be extirpated.

Acreages within wilderness areas are not included in tables 1 and 2. The amount of old-growth within most wilderness areas is not readily available, as timber resource inventories are not conducted in these areas. McClelland (1977) described wilderness as not particularly suited for an old-growth reserve because much of the land is contained in high alpine areas and not generally preferred by cavity-nesters. Recreation specialists in the Northern Region agree that much wilderness is contained in alpine areas, but point out that certainly much productive timber land is also contain in wilderness, such as the Bob Marshall and the Selway-Bitterroot Wildernesses (B. Worf 1978 personal communication). In the newly created Great Bear Wilderness, for example, there are 120,460 acres of timber

TABLE 1 -- ACRES OF "NATURE SAWTIMBER, HIGH RISK" FROM TIMBER COMPUTER INFORMATION, REGION ONE.

TIMBER TYPE	LOLO FOREST 1974			CLEARWATER FOREST 1973			BITTERROOT FOREST 1972			KOOTENAI FOREST 1977			FLATHEAD FOREST 1974		
	*MST/HR	**Totals	%	MST/HR	Totals	%	MST/HR	Totals	%	MST/HR	Total	%	MST/HR	Total	%
Douglas-Fir (DF)	154719.1	687874.8	22	1856.5	339466.0	0.54	17580.4	230070.7	7	49933.9	204684.9	24	46206.1	262332.2	17
Ponderosa Pine (PP)	14874.2	67759.5	21	.0	738.2	0	.0	.0		.0	5019.8	0	.0	1465.1	0
Western White Pine	.0	2396.2	0	.0	29146.5	0	.0	.0		.0	3174.1		.0	1930.8	0
Englemann Spruce (ES)	53377.4	347661.5	15.3	.0	130113.7	0	.0	.0		26530.1	88303.3		96391.9	189118.9	50
Subalpine Fir (SF) - ES	.0	10980.4	0	11661.2	56045.8		61277.8	104018.0	58	12467.0	48480.3		11756.3	84028.1	
Western Redcedar	3989.5	20021.1	20	13664.1	185624.5		.0	.0		24284.9	45662.7		1504.2	1504.2	
Mountain Hemlock -SF	.0	15176.3	0	.0	132867.5		.0	.0		20590.8	23225.8		.0	.0	
Western Hemlock	.0	579.0	0	.0	.0		.0	.0		24090.2	26539.6		.0	.0	
Larch - DF	36834.0	82300.3	44.7	13945.5	276633.3	5	.0	.0		19235.9	35026.6	54	4216.2	25787.2	16
Grand Fir-Larch - DF	10341.8	41821.3	24.6	.0	19275.5	0	.0	.0		49749.6	208408.7	23	19889.1	151780.1	13
Larch - PP-DF	.0	655.9	0	.0	.0		.0	.0		.0	.0		710.2	.0	0
Alp. Larch - SF-LP-WLP	.0	.0	0	.0	.0		.0	.0		.0	.0		.0	.0	0
Lodgepole Pine (LP)	.0	509280.9	0	.0	262716.4	0	19644.1	82517.7	23	.0	422068.1	0	60222.9	275644.5	
WLP (Whitebark-Limber Pines)	4822.8	28480.8	16.9	1879.3	1879.3		309.6	309.6		.0	.0		20076.4	23927.1	
Hardwoods	.0	.0	0	.0	10714.7	0	.0	.0		.0	.0		.0	1038.7	0
Subtotal	278959.3	1814987.7	15.4	43006.6	1445221.2	2.98	98811.9	209916.1	47.1	226822.3	1110593.9	20.4	260263.2	1019267.2	25.5
Non-Forest Types	.0	.0		.0	1277.7		.0	8854.9		.0	.0		.0	.0	
Total	278959.3	1814987.7	15.4	43006.6	1446498.9	2.98	98811.9	218771.0	47.1	226822.3	1110593.9	20.4	260263.2	1019267.2	25.5
Avg. Drain + (Acres)	10140.8			6390.4			3004.8			13216.8			6552.8		

Key to Table 1 at end of Table*

TABLE 1 CONTINUED

	ST. JOE FOREST 1972			COEUR D'ALENE FOREST 1970			KANIKSU FOREST 1975			IDAHO PANHANDLE FOREST 1974++								
	*MST/HR	**TOTALS	%	MST/HR	TOTALS	%	MST/HR	TOTALS	%	MST/HR								
Douglas-Fir (DF)	38614.2	190178.9	20	332.0	2083.6	15	8675.8	42711.6										
Ponderosa Pine (PP)	.0	3116.1		.0	.0		.0	.0										
Western White Pine	1762.0	57901.7	31	.0	39.1	0	3127.0	36845.3										
Englemann Spruce (ES)	57223.5	73404.6		142.8	17306.8	0.24	31420.7	267313.9										
Subalpine Fir (SF)-ES	6639.1	26617.3		.0	.0		2458.8	52299.0										
Western Redcedar	24861.2	45757.3	54.4	.0	1552.0	0	40956.1	132083.7										
Mountain Hemlock -SF	56655.6	59553.0		29.7	8464.4	0.34	.0	.0										
Western Hemlock	7080.3	7080.3	100	.0	195.9	0	17529.9	69959.6										
Larch - DF	94164.1	140140.3	67	58.2	6581.7	0.88	.0	165009.8										
Grand Fir-Larch-DF	6401.7	29867.2	21.4	.0	.0		4442.3	80454.0										
Larch-PP-DF	.0	.0		.0	.0		.0	52159.3										
Alp. Larch -SF-LP-WLP	.0	.0		.0	.0		.0	.0										
Lodgepole Pine (LP)	5029.2	140203.4	3.5	.0	4512.5	0	.0	35383.2										
WLP (Whitebark-Limber Pine)	.0	.0		.0	.0		.0	.0										
Hardwoods	.0	.0		.0	.0		.0	.0										
Subtotal	298431.0	773820.0	38.6	986.7	40736.0	2.4	108610.7	934219.3	11.6									
Non-Forest Types	4205.0	4205.0		.0	.0		.0	10636.6										
Total	302636.0	778024.9		986.7	40736.0	2.4	108610.7	944855.9	11.6									
Avg. Drain+(Acres)	1000.8			1025.0			1650.8			9417.4								

KEY TO TABLE 1:

* Mature Sawtimber, High Risk (MST/HR) - Stands which are expected to be severely decimated in 20-40 years due to old age, insects, or disease. Figures from "Pass Two" computer printouts (in acres).

** Totals - Refers to total acres of all six successional stages which include grass-forb (nonstocked), brush-seedling, pole-sapling, young (pole timber), mature (mature sawtimber, low risk), old growth (mature sawtimber, high risk).

+ Average drain for the period 1973-1977 (acres) - Assume equal cut among the timber types and assume the cut to be taken from the High Risk category.

++ Idaho Panhandle National Forest - Combination of Coeur d'Alene N.F., Kaniksu N.F., St. Joe N.F., and Colville N.F. in 1974.

TABLE 2 -- ACRES OF "MATURE SAW TIMBER, HIGH RISK" FROM FOREST TIMBER PLANS, REGION ONE

TIMBER TYPES	BEAVERHEAD FOREST 1969			CUSTER FOREST 1967			DEERLODGE FOREST 1968			LEWIS & CLARK FOREST 1958			GALLATIN FOREST 1965		
	*MST/HR	**TOTALS	%	MST/HR	TOTALS	%	MST/HR	TOTALS	%	MST/HR	TOTALS	%	MST/HR	TOTALS	%
Douglas-Fir (DF)	242.0	137.0	57	8915			148655	199162	74	145251	319619	45	62366	169117	36
Ponderosa Pine (PP)				25178						25097	42687	58			
Western White Pine															
Engelmann Spruce (ES)							21902	63898		30478	35280		72089	83330	
Subalpine Fir (SF)-ES	65.3	125.0	52.2												
Aspen								780							
Subalpine Fir										1338	4246		14545	37357	
Cottonwood										20	20				
SF - Cottonwood															
Larch															
Whitebark Pine															
Alp. Larch-SF-LP-WLP															
Lodgepole Pine (LP)	136.2	651.1	21				241737	571066			367416		203588	348473	
WLP (Whitebark-Limber Pines)		21.0					7581	10752		2940	11404			44549	
Hardwoods															
Subtotal	339.0	1038.4	32.6	34093	73783	46.2	419875	845658	49.7	243807	885934	27.5	353826	688826	51.3
Non-Forest Types	.0	.0		.0	.0		.0	.0		.0	.0		.0	.0	
Total	339.0	1038.4	32.6	34093	73783		419875	845658	49.7	243807	885934	27.5	353826	688826	51.3
Avg. Drain+ (Acres)	1364.2			62.2			1884.2			743.0			952.0		

Key to Table 2 at end of Table.*

TABLE 2 CONTINUED

TIMBER TYPES	HELENA FOREST 1969			NEZPERCE FOREST 1963			COLVILLE FOREST 1965						REGION ONE	
	MST/HR	TOTALS	%	MST/HR	TOTALS	%	MST/HR	TOTALS	%					%
Douglas-Fir (DF)		285069		34202	253177		68568	316675					Avg.%=	27.2
Ponderosa Pine (PP)		17322		80430	139876		25943	47332						
Western White Pine														
Englemann Spruce (ES)	2914	8673		11540	74909		29580	6577						
Subalpine Fir (SF)-ES														
Aspen														
Subalpine Fir	9764	57446												
Cottonwood														
SF-Cottonwood				8491	63040									
Larch				12610	47720		52808	196450						
Whitebark Pine							10352	15888						
Alp. Larch-SF-LP-WLP														
Lodgepole Pine (LP)	16711	308546		336473	380		14544	107594						
WLP (Whitebark-Limber Pines)		18826												
Grand Fir				106685	193691									
Subtotal	119625	695882	17.2	254338	1108886	22.9	172215	713519	24					
Non-Forest Types	.0	.0		.0	.0		.0	.0						
Total	119625	695882		254338	1108886		172215	713519	24				435.38%=27.2%	
	1305.6			4789.2			3466.4						66966.4	

KEY TO TABLE 2:

* Mature Sawtimber, High Risk (MST/HR) - Stands which are expected to be severely decimated in 20-40 years due to old age, insects, or disease. Figures from "Pass Two" computer printouts (in acres). Measurement in (M)= thousands of acres. Thus 136.2M= 136,200 acres.

** Totals - Refers to total acres of all six successional stages which include grass-forb (nonstocked), brush-seedling, pole-sapling, young (pole timber), mature (mature sawtimber, low risk), old growth (mature sawtimber, high risk). Measurement in (M)= thousands of acres. Thus 136.2M= 136,200 acres.

+ Average drain for the period 1973-1977 (acres) - Assume equal cut among the timber types and assume the cut to be taken from the High Risk category.

1/Figure should be lower, but no "High Risk" figures were available. Probably 17.3% instead of 27.5 old growth.

TABLE 2 SUPPLEMENTAL INFORMATION:

Data in table for Nezperce National Forest from mature stands with the following breakdown - (acres).

Mature Sawtimber, High Risk =	105,000
Mature Sawtimber, Low Risk =	126,000
Decadent, cull (Not Merchantable)=	23,000
Total Mature Sawtimber	254,000

Data in table for Colville National Forest not available for mature sawtimber, High Risk, and has the following breakdown (acres).

High Risk=	109,300
Low Risk =	89,900
Decadent=	5,000
Total=	204,200

producing lands with 480,664,000 board feet of mature merchantable saw timber and pole-size timber, mainly lodgepole pine (T. Kovalicky. 1978 personal communication). However, it is certainly unrealistic to rely upon wilderness as the sole supplier of old-growth for species dependent on old-growth. Such fragmentation of suitable habitat would not be acceptable for viable self-sustaining populations of old-growth-associated species (Meslow and Wight 1975, McClelland 1977). Allocation of old-growth from the timber base must be made for wildlife management. Specific recommendations for old-growth management follow.

MANAGEMENT RECOMMENDATIONS

One management strategy for cavity-nesting habitat is to retain a certain number of snags per acre (Thomas et al. 1976, Bull and Meslow 1977, Bull 1978). In addition, Thomas (1976) recognized ponderosa pine, larch, and deciduous trees as preferred snags, and recommended selection of the species where possible. Also, clumping of snags was encouraged. Several Regions of the Forest Service have already adopted snag management guidelines: USDA--FSM 2405.14, R-5 Supplement No. 114, 1978, and USDA--FSM 2631.12, R-4 Supplement No. 26, 1978. However, these management strategies supply only short-term solutions. For old-growth components to be available for wildlife, timber stands of old-growth must be available so that the ecological processes that produce these commodities may occur. "A program emphasizing sustained yield of snags and old-growth is essential." (McClelland 1977:351).

One management strategy to retain old-growth components for wildlife on a continuous basis is longer rotation times for managed stands. The option requires long-term, drainage-wide sale planning. McClelland (1977:351) suggested rotations longer than 200 years. Wildlife habitat may be enhanced as foraging openings adjacent to old-growth are created, and tree diameter growth is stimulated by thinning practices. The juxtaposition of old-growth and openings must be carefully planned for the enhancement of wildlife habitat and timber management. McClelland suggested leaving as a minimum, 10 percent of the ponderosa pine, western larch, and grand fir types as old-growth. The old-growth should be distributed throughout the management area, and the shape of old-growth units should be varied. Also, other components (snags, stumps, and so on) should be left throughout the area for nesting and feeding sites and security cover.

Biologists on the Lolo National Forest Planning Team suggested some stands have rotation periods of 250 years (USDA-Forest Service 1978). For 10 percent of the area to remain in old-growth at any one time, at least 28 percent of the area must be included in the 250-year rotation. Commerical thins would be allowed up to age 80 years to stimulate growth and produce at least 15 trees per acre greater than 21 inches d.b.h. by age 160 years.

After age 80, thinning would be discontinued to allow decadence and disease to occur. By age 250 years suitable old-growth habitat would be present.

Long rotations may not always be suitable for managing old-growth. Juday (1977) noted rotation strategies imply maximum timber output, and old-growth components such as snags and down material will decrease timber yield. These characteristics are "bad" for the rotation, and consequently may be eliminated from the stand. Also, long rotations might be too complicated to be effectively monitored. Members of the Lolo National Forest Planning Team suggested certain additional stands be permanently reserved in old-growth (USDA-Forest Service 1978). No modifications would be allowed in the stands to insure old-growth habitat would always be available. In addition, some areas with all-age stands would be suitable for individual tree selections or small group cuttings. The stands would meet the criteria for old-growth at all times, yet offer a certain amount of vegetative manipulation (USDA-Forest Service 1978). Considering the present demands on the timber resource, this approach to old-growth management seems reasonable from both a timber and a wildlife management viewpoint.

Winn (1976) encouraged a drainage-wide philosophy and recommended saving relic stands (25-30 ha) of old-growth timber.

Bull (1978) outlined management guidelines used on the Wallowa-Whitman, Malheur, Umatilla, and Ochoco National Forests. In summary, 5 percent of each timber type would be maintained as old-growth. The old-growth would be dispersed in three separate compartments of 6,300 acres to decrease loss due to fire, insects, or disease and to minimize the diversity. Stands would be at least 20 acres, and preferably 100 acres in size, or larger.

McClelland (1977) listed short-term management suggestions in the form of snag guidelines, as well as many long-term management suggestions. Some recommendations he mentioned include the following:

-educate the public (particularly woodcutters) about the habitat requirements of cavity-nesting birds

-establish wildlife habitat survey crews

-train Stage-I timber inventory crews to recognize and report wildlife habitat areas

-avoid harvesting trees from May 1 to June 15 to avoid disturbance to nesting birds

-protect riparian zones

-protect high stumps and some carpenter ant colonies to provide winter food supplies for woodpeckers

-leave culls as well as snags; culls will remain standing longer and thus provide nest sites longer than snags.

SUMMARY AND CONCLUSIONS

Historically, the components of old-growth forests, such as snags and decadent trees, have been viewed as undesirable. Efforts have been made to convert old-growth, unmanaged forests, to managed forests composed of even-age classes. W.O. Hagenstein (1977), Executive Vice-President of the Industrial Forestry Association, Portland, Oregon, described the need to salvage the timber in old-growth forest before it is lost. He declared professional foresters as "duty-bound to protect public health by preventing the waste of trees" (Hagenstein 1977:494). However, the old-growth forest is a complete ecosystem, and contains a unique set of ecological processes and attendant wildlife. Juday (1977) described the old-growth ecosystem in a paper entitled, "Old-Growth Forests: A Necessary Element of Multiple-Use and Sustained Yield National Forest Management". He suggested the following example (Juday 1977:505):

> As an example, consider the fate of a weakened old-growth Douglas-fir killed by a pathogen. The superficial view would be that a stand with such a tree is "suffering" from a "loss" and is "unhealthy". Yet, the standing snag may serve as a roost for insect-eating bats. A piletated woodpecker may begin to excavate a hole in its search for grubs and carpenter ants (which are gradually releasing the stored energy and nutrients in the snag back into the ecosystem). A pair of insectivorous birds may then nest in the hole and forage for their young along the live foliage surface of adjacent standing trees. The snag eventually falls. While on the ground it becomes moist, and several amphibians begin living there. Free living nitrogenfixing bacteria next inocluate the log. The log is then penetrated by mycorrhizal fungi which contact hemlock seedling roots. The hemlocks on the log's surface respond and begin growing rapidly toward the canopy opening. The log breaks into sections, and one piece rolls into the stream. The piece wedges with others to form a debris dam which traps a sediment pool. Stream sediment is filtered and the banks stabilized. Aquatic boring and shredding insects attack the log and decompose it further, supporting the stream food web. Viewed in this light, what would the "loss" have been if there were no snag?

Obviously, traditional forestry practices will conflict with old-growth management for dependent wildlife species. However, as a manager of public lands, the Forest Service must satisfy both timber and wildlife interests.

The key to this role is a holistic approach to management. An ecosystem framework considers all resources of the system. Correspondingly, goals and objectives should be established, and priorities should be assigned based on reasonable and logical thought. Both interests may not simultaneously be served on the same acre of land. However, through consideration and review, compromises shall be reached so that all components and processes of the ecosystem are perpetuated.

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APPENDIX A

SPECIES PREFERRING OLD-GROWTH FOR REPRODUCTION OR FEEDING

SPECIES	OLD-GROWTH COMPONENT USE	HOME RANGE OR TERRITORY OR MINIMUM STAND SIZE OF OLD-GROWTH REQUIRED[1/]
Snowshoe Hare	Will use all other successional stages for feeding & reproduction. Uses down material for reproduction, security cover (5).	Home Range (HR)=10 ac. (1)
Wolverine	"Wilderness-associated" species (1) considered to need undisturbed areas for security. Will use other stages for feeding and reproduction. May use down logs for cover (5). No aversion to clearcuts or roads if cover is nearby. A very wide ranging mammal (2).	HR=150-200+mi.^{2} (2)
Lynx	Dens in hollow log (5). Uses mature stands for security cover. (1) Will use all other stages for feeding and reproduction. Population follows the snowshoe hare (2).	HR=6-15 mi.^{2} (1,2), Min. stand=640 ac. (8)
Black & White Warbler	Will use stages 2-6[2/] for reproduction and feeding. Habitat: woodlands, trunk, limbs of trees.	

1/ N/A = Not available
T = Territory
HR = Home Range
Min. Stand = Minimum stand size of old-growth necessary to support a viable population.

2/ Successional Stages:

1. grass-forb
2. brush-seedling
3. pole-sapling
4. young
   mature
5. old growth

SPECIES PREFERRING OLD-GROWTH FOR REPRODUCTION OR FEEDING

SPECIES	OLD-GROWTH COMPONENT USE	HOME RANGE OR TERRITORY OR MINIMUM STAND SIZE OF OLD-GROWTH REQUIRED
Porcupine	Will use all other stages for feeding and reproduction. Feeds on cambium. Uses down material, hollow trees for feeding, reproduction & other uses (5).	
MacGillivray's Warbler	Uses all other stages. Habitat - dense undergrowth, shady areas.	
Northern Parula	Uses all other stages.	
Goshawk	Uses other stages, may prefer heavily timbered, mature-old stands (3). Nests in large size trees (3).	HR=525 acres; T=6-15 (3) Min. stand size=80 ac. (8)
Great Blue Heron	Needs large size trees to hold large platform nest. Nests in colonies (3).	Min. stand size=20 ac. (8)
Great Gray Owl	Habitat-dense forests with adjacent meadows (3).	N/A; perhaps 1 $mi.^2$ (3)
Common Flicker	Nests in last 3 stages. Uses all stages of succession for feeding, nests in cavities. Needs 12 in. dbh snag (4).	Territory radius=½ mi. (3), T=7 ac. (6), needs min stand size of 10 ac. (8), T=40 ac. (7)
Red-headed Woodpecker	Feeds in stages 2-6, nests in cavities in last 3 stages.	N/A
White-headed Woodpecker	Feeds in stages 2-6, nests in cavities of minimum 10 in. dbh (4). May need large tracts of ponderosa pine (3). Prefers snags of 24 in. in dbh for nesting (3). Forages on scaly bark of mature ponderosa pine. Nests in last 3 stages.	N/A (3), T=20 ac. (7), min. stand size=80 ac. (8)

SPECIES PREFERRING OLD-GROWTH FOR REPRODUCTION OR FEEDING

SPECIES	OLD-GROWTH COMPONENT USE	HOME RANGE OR TERRITORY OR MINIMUM STAND SIZE OF OLD-GROWTH REQUIRED
Pileated Woodpecker	Feeds on carpenter ants in winter which are found on snags, culls, and tall stumps above snow line (6). Nests in a snag with minimum dbh of 20 in. (4). Prefers western larch and ponderosa pine over Douglas-fir for nesting (6). Will use last 4 stages for feeding and last 3 stages for nesting.	Territory for 1 pair= 500-1,000ac (6), T=300ac (7), Minimum stand size needed=160ac (8)
Lewis' Woodpecker	Nests in snags. Uses last 5 stages for feeding. Needs snag with minimum d.b.h. of 12 in (4). Nest in last 3 stages.	Not territorial, and is protective only of nest area (3), T=10ac (7), min stand=80ac (8)
w-bellied Sapsucker	Nests in last 3 stages. Nests in snag cavity of min 10 in d.b.h. (4). Feeds in all successional stages.	T=5ac (6), T=10ac (7) min stand size=80ac (8)
Williamson's Sapsucker	Nests in last 3 stages. Feeds in last 5 stages. Nests in cavity of at least 12 in d.b.h. (4).	T=10ac (7), min stand= 80ac (8)
Hairy Woodpecker	Feeds in last 5 stages of succession. Nests in cavity of at least 10 in d.b.h. (4). Nests in last 3 stages.	T=20ac (6), T=25ac (7), min stand size=20ac (8)
Downy Woodpecker	Generalist feeder in stages 2-6. Nests in cavity of min 6 in d.b.h. (4). Nests in last 3 stages.	T=10ac (7)
Black-backed three-toed Woodpecker	Nests in cavity of at least 12 in d.b.h. (4). Feeds in stages 3-6. Eats many "harmful" forest insects. Nests in last 3 stages.	
Northern three-toed Woodpecker	Same as above.	Average breeding territory =106ac (3), T=75ac (7), min stand size=80ac (8)

SPECIES PREFERRING OLD-GROWTH FOR REPRODUCTION OR FEEDING

SPECIES	OLD-GROWTH COMPONENT USE	HOME RANGE OR TERRITORY OR MINIMUM STAND SIZE OF OLD-GROWTH REQUIRED
White-breasted Nuthatch	Cavity nester, requires 12 in d.b.h. min (4). Feeds in stages 3-6. Nests in last 3 stages.	Min stand=20ac (8)
Red-breasted Nuthatch	Same as above.	T=10ac (6), min stand size=20ac (8)
Pygmy Nuthatch	Same as above.	Min stand=20ac (8)
Screech Owl	Feeds in first 2 stages of succession. Nests in cavity of snag of min 12 in d.b.h. (old woodpecker hole) (4).	Min. stand=20ac (8)
Flammulated Owl	Same as above.	Min stand=80ac (8)
Pygmy Owl	Feeds in stages 1, 2, 3. Nests in cavity. Uses old woodpecker hole. Snag must be min of 12 in (4).	Min stand=20ac (8)
Saw-whet Owl	Same as above.	Min stand=80ac (8)
Barred Owl	Nests in cavity or old hawk nest. Feeds in first 3 stages of succession. Needs snag of at least 20 in d.b.h. (4).	
Purple Martin	Nests in cavity. Feeds in first 2 stages.	
Vaux's Swift	Will use 4 stages for nesting and first 4 for feeding. Nests in cavity, snag must be at least 20 in d.b.h. (4).	Min. stand=20ac (8)

SPECIES PREFERRING OLD-GROWTH FOR REPRODUCTION OR FEEDING

SPECIES	OLD-GROWTH COMPONENT USE	HOME RANGE OR TERRITORY OR MINIMUM STAND SIZE OF OLD-GROWTH REQUIRED
Great-creasted Flycatcher	Will utilize stages 3-6 for reproduction and stages 2-4 for feeding.	N/A
Violet-green Swallow	Will use stages 3-6 for reproduction, stages 1-4 for feeding. Needs cavity of at least 10 in d.b.h. (4).	N/A
Tree Swallow	Same as above.	
Brown Creeper	Will use stages 4-6 for reproduction and 3-6 for feeding. Cavity must be in snag of min 10 in d.b.h. (4).	T=5ac (6), min stand size=20ac (8)
House Wren	Will use stages 2-6 for reproduction and stages 1-4 for feeding. Cavity must be in snag of minimum 10 in d.b.h. (4).	N/A
Hermit Thrush	Usually prefers interior of the forest (Winn 1976). May be adversely affected by logging practices (Franzreb 1977).	Min stand size=20ac (8)
Eastern Bluebird	Will nest in cavity in stages 2-6, and feed in stages 1-3. Minimum d.b.h. for snag-bearing cavity is 10 in (4). Logging may benefit this species as long as suitable nest sites are not limiting (Franzreb).	T=40ac (6)
Mountain Bluebird	Same as above.	
Long-legged Myotis	Will nest in stages 4-6 and feed in stages 1-6. Need a cavity in snag of 12 in d.b.h. (4).	Min stand=160ac (8)
California Myotis	Same as above.	Same as above.

SPECIES PREFERRING OLD-GROWTH FOR REPRODUCTION OR FEEDING

SPECIES	OLD-GROWTH COMPONENT USE	HOME RANGE OR TERRITORY OR MINIMUM STAND SIZE OF OLD-GROWTH REQUIRED
Silver-haired Bat	Will nest in stages 2-6 and feed in stages 1-3. Needs a snag of min 12 in d.b.h. for suitable cavity (4).	Min stand=160ac (8)
Big Brown Bat	Same as Silver-haired Bat.	Same as Silver-haired Bat.
Barn Owl	Will nest in the last 2 stages of succession and feed in stages 1, 2, 5, & 6. Rural areas and buildings are good habitat. Needs d.b.h. of 20 in for proper cavity in snag (4).	N/A
Boreal Red-back Vole	Will reproduce in the last 4 stages of succession, will feed in the last 5 stages. Prefers old-growth habitat for both activities. Is slightly aboreal (4).	HR=¼ac (1), min stand=20ac (8)
Fisher	Will utilize last 4 stages of succession for reproduction and first 4 stages for feeding. Animal is slightly arboreal and often is found in mature to old stands (2).	Travels widely-HR=150mi^2 (2), HR=10mi^2 (1), min stand=1,000ac (8)
Marten	Will utilize last 4 stages for reproduction, and will feed in last 5 stages. Animal is slightly arboreal and often is found in mature to old stands (2).	HR-1mi^2, males, ¼mi^2, females (1), territory= 15mi (1), min stand= 640ac (8)
Woodland Caribou	Winter resident in Northern Region. Depends on mature to old stands as winter habitat. Also, depends upon mature spruce-fir forests for winter food (lichen) production (Freddy 1974).	Minimum area for viable population-200=mi^2.

SOURCES (For Appendix A)

(1) Burt and Grossenheider 1976.
(2) H. Hash, 1978. Personal Communication.
(3) Jackman and Scott 1975.
(4) Thomas et al. 1976.
(5) Maser et al. 1977.
(6) McClelland 1977.
(7) Bull 1978.
(8) J. Deibert, 1978. Personal Communication.

APPENDIX B.

SNAG-OR CAVITY-DEPENDENT WILDLIFE SPECIES IN THE NORTHERN REGION

PRIMARY USER (Species excavate or dig a new nest cavity each year.)

Red-headed Woodpecker
White-headed Woodpecker
Pileated Woodpecker
White-breasted Nuthatch
Common Flicker
Lewis' Woodpecker
Yellow-bellied Sapsucker
Williamson's Sapsucker
Hairy Woodpecker
Downy Woodpecker
Black-backed Three-toed Woodpecker
Northern Three-toed Woodpecker
Red-breasted Nuthatch
Pygmy Nuthatch

SECONDARY USER (Species are generally incapable of excavating their own cavities. Species recycle abandoned woodpecker cavities of previous years.)

Brown Creeper
Black-capped Chickadee
Boreal Chickadee
Mountain Chickadee
Chestnut-backed Chickadee
Western Bluebird
Mountain Bluebird
Starling
House Sparrow
Violet-green Swallow
Tree Swallow
Purple Martin
Vaux's Swift
House Wren
Great-crested Flycatcher
Ash-throated Flycatcher
Long-eared Myotis
California Myotis
Little brown Myotis
Yuma Myotis
Long-legged Myotis
Silver Haired Bat
Big Brown Bat

Wood Duck
Harlequin Duck
Common Goldeneye
Barrow's Goldeneye
Bufflehead
Hooded Merganser
Common Merganser
American Kestrel
Eastern Fox Squirrel
Northern Flying Squirrel
Southern Flying Squirrel
Racoon
Marten
Fisher
Barn Owl
Hawk Owl
Boreal Owl
Screech Owl
Flammulated Owl
Pygmy Owl
Saw-whet Owl
Barred Owl

APPENDIX C.

WILDLIFE SPECIES DEPENDENT ON NATURAL OLD-GROWTH

Hermit Thrush
Goshawk
Boreal Red-back Vole
Fisher
Wolverine
Lynx

APPENDIX D.

WILDLIFE SPECIES TOLERATING LIMITED MANAGEMENT

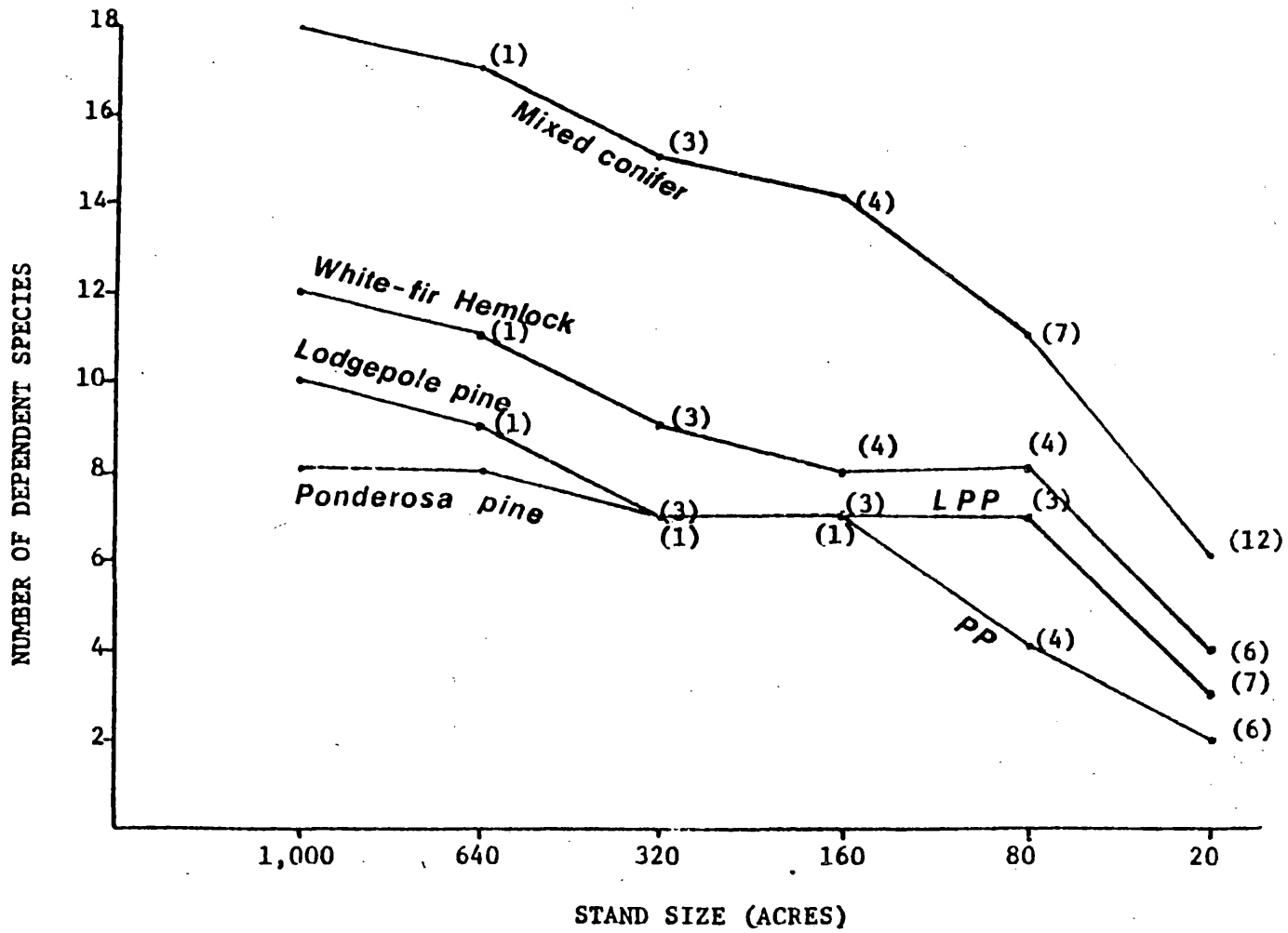
Clark's Nutcracker
Ruby-crowned Kinglet
Townsend's Warbler
Red Crossbill
Hammond's Flycatcher
Black-headed grosbeak
Evening Grosbeak
Bald Eagle
Great Gray Owl
White-breasted Nuthatch
Saw-whet Owl
Chestnut-backed Chickadee
Northern Flying Squirrel
Dusky Shrew
Marten
Little Brown Myotis
White-winged Crossbill
Merlin
Barred Owl
White-headed Woodpecker
Western Jumping Mouse
Pileated Woodpecker

APPENDIX E.

WILDLIFE SPECIES TOLERATING MODERATE MANAGEMENT

Raven
Rough-legged Hawk
Turkey Vulture
Western Flycatcher
Long-eared Owl
Screech Owl
Flammulated Owl
Pygmy Owl
Western Wood Pewee
Mountain Chickadee
Black-capped Chickadee
Yuma Myotis
Fringed Myotis
Red-tailed Hawk
Osprey

APPENDIX J



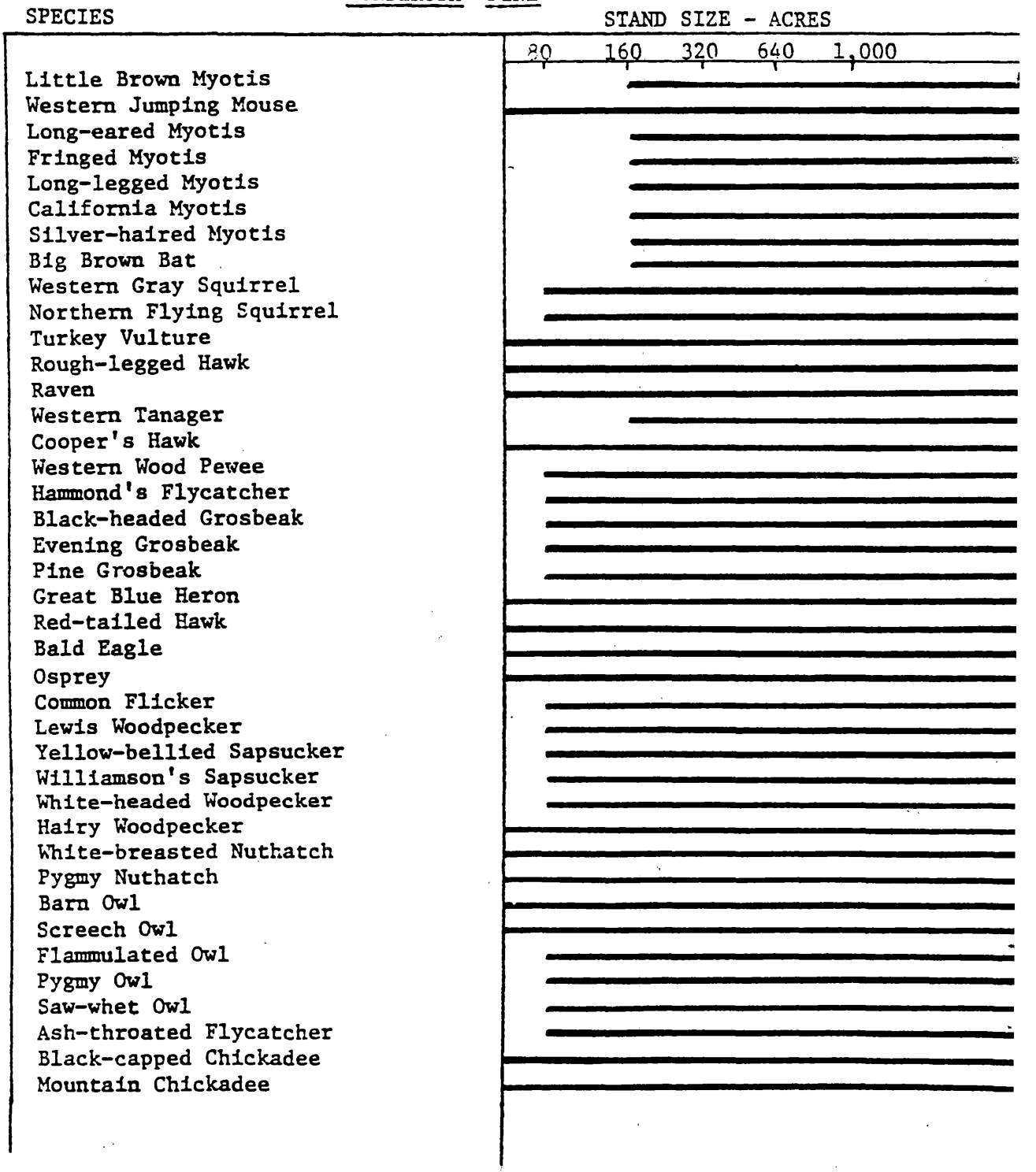
( ) Numbers Lost Due to Stand Size

Figure 1 -- Number of old-growth dependent species lost with decreasing stand size.

APPENDIX J-1

ROTATION TIMBER STANDS BY STAND SIZE

PONDEROSA PINE



APPENDIX J-1

ROTATION TIMBER STANDS BY STAND SIZE

SUBALPINE FIR - WHITEBARK PINE

SPECIES	STAND SIZE _ ACRES 80 160 320 640 1,000
Western Jumping Mouse	
Marten	
Fisher	
Northern Flying Squirrel	
Western Red-Backed Vole	
Raven	
Hermit Thrush	
Western Flycatcher	
Clark's Nutcracker	
Ruby-crowned Kinglet	
Golden-crowned Kinglet	
Yellow-rumped Warbler	
Townsend's Warbler	
Western Tanager	
Red Crossgill	
White-winged Crossbill	
Merlin	
Long-eared Owl	
Western Wood Pewee	
Hammond's Flycatcher	
Evening Grosbeak	
Pine Grosbeak	
Hairy Woodpecker	
Black-backed 3-Toed Woodpecker	
Northern 3-Toed Woodpecker	
Mountain Chickadee	

Key to Appendix J-2

DR = DEPENDENCY RATING: Overall rating which reflects the species requirement or dependency on old growth stands. (marked as VH - Very High to L - Low)

ML = MANAGEMENT LEVEL: The level of tolerance a species has to timber practices.

Defined as:

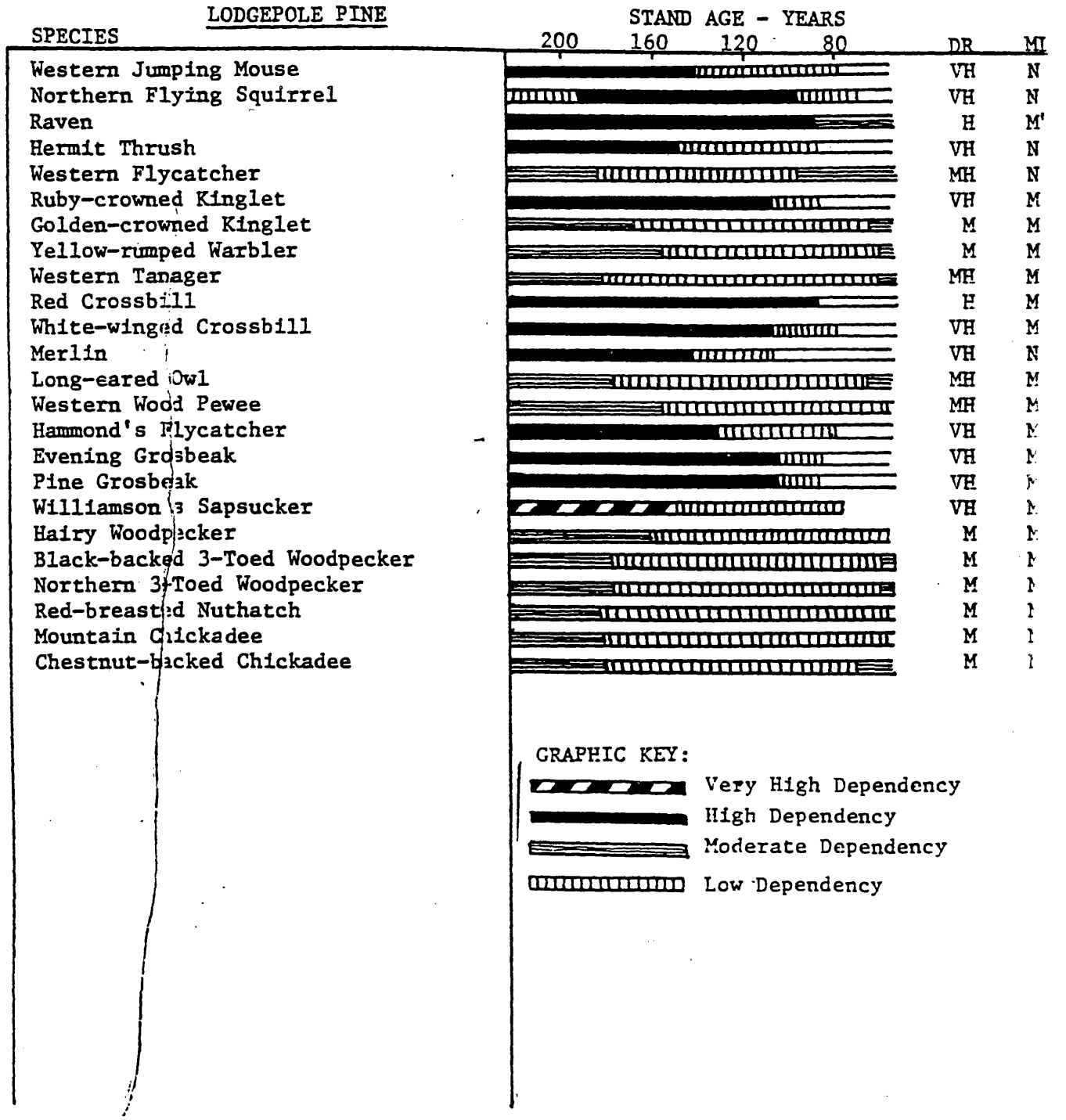
N = Species requires natural (relatively undisturbed) old-growth stan

M' = Species requires old-growth component; species tolerates certain timber harvesting practices (salvage, and select tree removal).

M" = Species requires old-growth component; tolerates timber practice including salvage cutting, commercial thinning, and patch cuts to 2 acres.

APPENDIX J-2
ROTATION TIMBER STANDS BY STAND AGE

LODGEPOLE PINE



APPENDIX K

SERIES	ORDER*	FOREST ECOLOGICAL GROUPING	HABITAT TYPES
PIFL Limber pine	24	Group 1 Limber pine/wheatgrass-fescue-juniper	Pinus flexilis/Agropyron spicatum /Festuca idahoensis /Juniperus communis
PIPO Ponderosa pine	5	Group 2 Ponderosa pine/bluestem wheatgrass-fescue-bitterbrush	Pinus ponderosa/Andropogon spp. /Agropyron spicatum /Festuca idahoensis /Purshia tridentata
	1	Group 3 Ponderosa pine/snowberry-chokecherry	Pinus ponderosa/Symphoricarpos albus /Prunus virginiana
PSME Douglas fir	6	Group 4 Douglas fir/wheatgrass-fescue-snowberry	Pseudotsuga menziesii/Agropyron spicatum /Festuca idahoensis /Festuca scabrella /Symphoricarpos oreophilus
	9	Group 5 Douglas fir/huckleberry-pinegrass-kinnikinnick	Pseudotsuga menziesii/Vaccinium caespitosum /Calamagrostis rubescens Arctostaphylos phase
	2	Group 6 Douglas fir/snowberry-ninebark-pinegrass	Pseudotsuga menziesii/Physocarpus malvaceus /Symphoricarpos albus Calamagrostis phase Symphoricarpos phase
	11	Group 7 Douglas fir/huckleberry-twinflower	Pseudotsuga menziesii/Vaccinium globulare /Linnaea borealis

* Group order by wildlife preference for old-growth. 1 = "most preferred"

SERIES	ORDER	FOREST ECOLOGICAL GROUPINGS	HABITAT TYPES
PSME (cont'd.)	10	Group 8 Douglas fir/pinegrass-snowberry-wheatgrass-ponderosa pine	Pseudotsuga menziesii/Calamagrostis rubescens Agropyron spicatum phase Pinus ponderosa phase /Symphoricarpos albus Agropyron spicatum phase
	16	Group 9 Douglas fir-pinegrass-sedge	Pseudotsuga menziesii/Calamagrostis rubescens Calamagrostis phase /Carex geyeri
	35	Group 10 Douglas fir/spirea-kinnikinnick	Pseudotsuga menziesii/Spirea betulifolia /Arctoslaphylos
	28	Group 11 Douglas fir/juniper-arnica	Pseudotsuga menziesii/Juniperus communis /Arnica cordifolia
PICEA Spruce	19	Group 12 Spruce/beadlily-huckleberry	Picea/Clentonia uniflora /Vaccinium caespitosum
	20	Group 13 Spruce/ninebark-bedstraw twinflower-Solomon's seal	Picea/Physocarpus malvaceus /Galium triflorum /Linnaea borealis /Smilacino stellata
	17	Group 14 Grand fir/beargrass-beadlily-twinflower	Abies grandis/Xerophyllum tenax /Clintonia uniflora /Linnaea borealis

SERIES	ORDER	FOREST ECOLOGICAL GROUPING.	HABITAT TYPES
THPL Red cedar	7	Group 15 Red cedar-Hemlock/beadlily	Thuja plicata/Clintonia uniflora Tsuga heterophylla/ Clintonia uniflora
	8	Group 16 Red cedar-Subalpine fir-Spruce/devil's club-horsetail	Thuja plicata/Oplopanax horridum Abies lasiocarpa/Oplopanax horridum Picea/ Equisetum arvense
ABLA Subalpine fir	12	Group 17 Subalpine fir/ beadlily-bedstraw-twinflower	Abies lasiocarpa/Clintonia uniflora /Galium triflorum /Linnaea borealis
	14	Group 18 Subalpine fir/ huckleberry	Abies lasiocarpa/Vaccinium caespitosum
	13	Group 19 Subalpine fir/bluejoint	Abies lasiocarpa/Calamagrostis canadensis
	18	Group 20 Subalpine fir-Hemlock/ menziesia-alder	Abies lasiocarpa/Menziesia ferruginea /Aluns sinuata Tsuga mertensiana/Mensiesia ferruginea
	23	Group 21 Subalpine fir-Hemlock/ beargrass-huckleberry	Abies lasiocarpa/Xerophyllum tenax Vaccinium globulare phase /Vaccinium globular Tsuga mertensiana/Xerophyllum tenax
	21	Group 22 Subalpine fir/beargrass-huckleberry-sedge	Abies lasiocarpa/Xerophyllum tenax Vaccinium scoparium phase /Vaccinium scoparium /Carex geyeri Carex geyeri phase

SERIES	ORDER	FOREST ECOLOGICAL GROUPINGS	SPECIES
POTR Aspen	36	Group 31 Aspen/subalpine fir-spruce-douglas fir	Populus tremuloides Populus tremuloides/Abies lasiocarpus /Picea /Pseudotsuga
FEID-FESC Festuca idahoensis Festuca scabrella	29	Group 32 Fescue-Wheatgrass	Festuca idahoensis/Agrophronsmithii A. dosystachyum /Agropyron spicatum /Carex filifolia /Stipa richardsonii /Agropyron canium /Deschampsia caespitosa
DECA Deschampsia caespitosa	33	Group 33 Tufted hairgrass-Sedge-Rush	Deschampsia caespitosa/Carex spp.
AGSP Agropyron spicatum	30	Group 34 Wheatgrass-Needlegrass	Agropyron spicatum/Bouteloua gracilis /Agropyron smithii- A. dasystachyum /Poa sandbergii
Prairie	31	Group 35 Bluestem	Andropogon
ARTRID-ARTRIP ARPE	32	Group 36 Sagebrush	Artemisia tridentata/Agropyron spicatum /Festuca scabrella /Festuca idahoensis Artemisia tripartita/Festuca idahoensis Artemisia pedatifida/Festuca idahoensis
Alpine	27	Group 37 Conglomerate	Conglomerate, barren, meadows

SERIES	ORDER	FOREST ECOLOGICAL GROUPING	HABITAT TYPES
ABLA (cont'd.)			
	15	Group 23 Subalpine fir/pinegrass-arnica-sedge	Abies lasiocarpa/Calamagrostis rubescens /Arnica cordifolia /Carex geyeri Pseudotsuga menziesii phas
	37	Group 24 Subalpine fir-Spruce/groundsel-virgin's bower	Albies lasiocarpa/Clematis pseudoalpina Picea/Senecio streptanthifolius
	25	Group 25 Subalpine fir-Hemlock/wood rush-gooseberry-huckleberry	Abies lasiocarpa/Luzula hitchcockii /Ribes montigenum Tsuga mertensiana/Luzula hitchcockii Abies lasiocarpa- Pinus albicaulis/Vaccinium scoparium
	26	Group 26 Subalpine fir -Whitebark pine-Alpine larch	Abies lasiocarpa Pinus albicaulis Larix lyallii
PICO Lodgepole pine	22	Group 27 Lodgepole pine	Pinus contorta
Hardwoods	3	Group 28 Elm-Ash-Cottonwood-Dogwood	SPECIES Populus trichocarpa/Pinus ponderosa /Betula papyrifera Populus trichocarpa Fraxinus pennsylvanica Ulnus americana
Deciduous (shrubby) Bottomland	4	Group 29 Willow-Birch-Alder-Aspen	Salix/Betula occidentalis
SCREE	34	Group 30 Scree	Scree/Pinus ponderosa /Pseudotsuga /Pinus flexilis /Abies lasiocarpus